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CENTRAL INTELLIGENCE AGENCY



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No 3, March 1962

Vestnik Protivovozdushnoy Oborony, No 3, March 1962

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Summary:

Jr Sgt ROMANTSOV's crew members are attempting to raise their ratings and to master contiguous specialties. The crew has achieved full interchangeability.

Aviation Mechanic Boris KONOVALOV has passed an examination in aircraft maintenance.

All military personnel of one podrazdeleniye are now rated as specialists.

Among ten rationalization suggestions, introduced by Komsomol member Valentin REZNICHENKO, is a working model of a radiotechnical apparatus.

Sr Sgt BORISOV and Pvt YEGOROV have successfully challenged their fellow servicemen to master all aspects of the communications apparatus of their podrazdeleniye.

M. P. DEVYATAYEV, Guest of Troops -- By Maj V. MIKHAYLOV (Page 2)

Summary:

Mikhail Petrovich DEVYATAYEV, HSU, related his World War II experiences, which included 35 aerial battles and the shooting down of nine German aircraft, to a chast'. DEVYATAYEV was shot down and imprisoned, but managed to escape by capturing a Heinkel 111 bomber and flying it back to Soviet territory. (A captioned photograph shows DEYATAYEV speaking with members of the chast'.)

Make a Choice (Page 2)

Col N. LISUN describes the activities of a propaganda team, composed of Lt Col LUKOVNIKOV, Maj GRYAZEV, and other officers. The team flies from garrison to garrison in an aircraft, piloted by Capt PLYTNIK, with a small library and graphic propaganda materials.





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Capt S. RAKOVSKIY describes pre-election activities at a propaganda station of an air chast'. Officers ROZHNENKO, BARANOV, and BYKOVSKIY are described as answering political questions for voters.

Train the Defenders of the Fatherland in the Spirit of Conscientious Military Discipline -- Editorial (Pages 3-7)

Summary:

"The work of the 22nd Congress of the CPSU becomes more significant with each day. The communist Soviet Army and Navy have, through technical and moral achievements, grown able to deal any aggressor an annihilating blow. An important aspect of this growth to combat readiness and capability is individual and conscientious military discipline. The Communist Party continues to lead the defense of the achievements of the October Revolution by uniting the Soviet masses as it did in the past. The difficult but honorable assignments, which the Party issues in conformance with history, can only be resolved by means of conscientious military discipline, which becomes more important with each new development of complicated combat equipment. This conclusion is of special importance to PVO Strany Troops, whose highly technical combat equipmentcan only be fully utilized when each soldier can accurately fulfill his responsibility. Young people, who have recently entered the service, are under an additional strain bedause they also must adapt themselves to service life.

The strengthening of military discipline is essential to all training and educational work, for this is the basis for the successful execution of all military missions. The podrazdeleniye in which Officer TITOV serves has achieved success in combat and political training because of firm military discipline, skillful organization, and attention to the individual needs and cultural problems of its officers and sergeants. But this fine example is not prevalent in all podrazdeleniya because all soldiers have not attained the level of conscientiousness necessary to meet the demands of army life. When a lack of concern is manifested, it is followed by violations of military discipline, which in turn may lead to serious consequences. Commanders, political organs, and party and Komsomol organizations must strive to develop regulated order and firm discipline. They cannot accomplish this until they realize that their daily work is the foundation for developing high combat and political qualities in soldiers. Service in the Soviet Army is an important stage in the formation of the world outlook of young people. Their moral and political outlook must reflect loyalty to the Soviet cause and to the defense of their Fatherland. Therefore, they must be guided by political activists in their studies of the history of the Soviet Armed Forces and of the factors of combat capability and readiness. Training, to develop conscientious military discipline, must include work with individuals. Further, there is no substitute for the high demandingness of commanders. A commander should organize his life to staisfy military regulations, and tolerate no deviations from military order. Demandingness is not an innate quality, but a developed trait for which some commanders sometimes substitute coarseness or even insults. This kind of misunderstanding is alien to the spirit of the Soviet Army and must therefore be eliminated. One-man commanders and political organs can be particularly effective in this effort because they are responsible for the conduct of personnel. Properly trained and disciplined sergeants can also be of invaluable aid.

Finally, a paternal attitude of commanders toward their subordinates has special significance among the PVO Strany Troops in strengthening the combat capability which in turn, can be accomplished only through maintaining conscientious military discipline."



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One-Man Command and the Authority of the Commander -- by Lt Gen I. F. KHALIPOV (pages 8-13)

Summary:

The 22nd Congress, CPSU, devoted much attention to strengthening the defensive capabilities of our Fatherland. The Party deems the principle of one-man command to be an integral part of increasing the combat readiness of the Armed Forces since one-man command is the most expedient method of managing troops. Centralized direction of troops is especially important in contemporary warfare, but it places a tremendous importance on the ability of a commander to make quick, firm decision and to be persistent in upholding military order. Thus, commanders of podrazdeleniya, chasti, and soyedineniya must be granted full authority.

Victory in combat is forged in peacetime training. Here again, one-man command permits the creation of an organic bond between the commander and his subordinates during training because a one-man commander has undivided responsibility for training, and all activities of his subordinates.

Always striving to strengthen one-man command, the Party is constantly ready to act against any attempts to make any sphere of the military independent from Party leadership. Thus, former Minister of Defense, USSR ZHUKOV was firmly censured when he attempted to establish an abusive style of troop administration, which would have used rudeness and coercion as substitutes for command demandingness. This would have weakened command authority and one-man command. The Party has the responsibility to train commanders equal to all the demands of contemporary military theory and practice and to strengthen military discipline. One-man command is built

on a Party basis, hence the Soviet commander is not only a military leader, but the political teacher and moral tutor of his subordinates.

Political organs and party organizations, as essential aids to one-man commanders, resolve questions of training and educating military personnel. A commander, who puts the ideas of the Communist Party into practice and who acts in close concord with political organs, can fulfill his responsibility as a one-man commander. Some fine examples of such commanders are Officers SITNIKOV, VOROBEY, KORKODILOV, NIKANOROV, and Col BOGUSHEVICH.

Without a party-state approach, a commander has no genuine authority, nor is he an authentic one-man commander. Maj AZIMOV was commander of a leading radar company, but he volunteered to take over the command of a podrazdeleniye which was lagging behind. That formerly backward podrazdeleniye, thanks to Maj AZIMOV's leadership, is now outstanding in combat and political training and in discipline.

The authority of a one-man commander depends upon his maturity, training, and principles. Capt KARLIN's podrazdeleniye is outstanding because this officer conscientiously fulfills all service responsibilities which results in his subordinates affording him deep respect and authority. He has high demandingness toward himself as well as towards his subordinates, but he also loves his soldiers and is able to fully use every means for their training and education. Maj ZABIYAK enjoys great authority in the podrazdeleniye which he commands because his thorough theoretical training and political keenness allow him to effectively influence all officers of his podrazdeleniye.

Discipline and military order are the results of high demandingness and faith in subordinates. Coarseness, shouts, and humiliation lead to poor results. There are still some commanders who do not understand this. There are also some commanders who believe that familiarity leads to respect. Nothing is further from the truth. A one-man commander trains personnel by putting a lively spirit into labor, by keeping abreast of the times, by ably directing the activity of subordinates, and by depending on party and Komsomol organizations.

There are many new, young officers entering the ranks of PVO Strany, who do not yet have sufficient command experience and skills. These young officers must be instructed in the skills of political and educational work, so that they may resolve the many complex problems of the defense of the air spaces of the Fatherland.

Self-criticism is essential to one-man command. Here again, party and political organizations are of the utmost assistance. This does not include fault-finding based on resentment. Officer MOSKOVITIN was found guilty of such a deviation when he criticized his commander's demandingness. These instances are rare, but they cannot be tolerated.

The strengthening of one-man command is a question of national importance for it is one of the decisive conditions necessary to fulfill the requirements of the Party to maintain the might of the Soviet State, and defeat any enemy who dares to infringe upon the Soviet Fatherland.

<u>Komsomol Soldiers Prepare for the 14th Komsomol Congress</u> -- by Capt V. A. MITROSHENKOV (Pages 14-16)

Summary:

The 12th Komsomol Plenum in November of 1961 decided to hold the regular 14th Komsomol Congress in April 1962. This will be a significant event in the lives of all Komsomol members and Soviet youth. They have applied the program of the 22d Congress CPSU to their own lives and are currently contributing all their knowledge, energy, and skill for its fulfillment. A movement is under way among Komsomol members of the Moscow PVO District to master combat skills, to raise combat readiness, and to strengthen discipline in honor of the forthcoming 14th Komsomol Congress.

Capt YERKOVETS leads a program in Komsomol organizations for raising ratings. Senior service personnel are aiding new members of the military to master combat skills and are working to perfect their own knowledge. Other Komsomol members, who are fine examples of the pledge "Every Komsomol Member, Outstanding" are Lts DRANNY and KOROLEV.

Books and albums are being prepared in the district, which contain the names of personnel who have increased the length of time between equipment overhauls, who have increased the tactical and technical capabilities of equipment, who have innovated methods to save materials, etc. The names already listed include Capt POSTNOV's.

Veteran Komsomol members such as the group headed by Maj Gen (Ret) SULEM and Col (Ret) MOROZOV are very active in district propaganda work.

Typical of the work to prepare for the coming Komsomol Congress is that of the Komsomol members led by Capt MIZAVTSOV. In cooperation with local Komsomol organizations, they have created mass defense circles, aided in training, and organized defense training.

Thus, each day, Komsomol members set new records in combat and political training and do their share to increase combat readiness.

(A captioned photograph of Tech-Lt KOVALENKO, specialist first class, by P. GORDIYENKO appears on page 15)

## ANTIAIRCRAFT ROCKET TROOPS

Knowledge of Equipment for Every Operator -- by Maj Gen Arty I. G. Zhilin (Pages 17-20)

Summary:

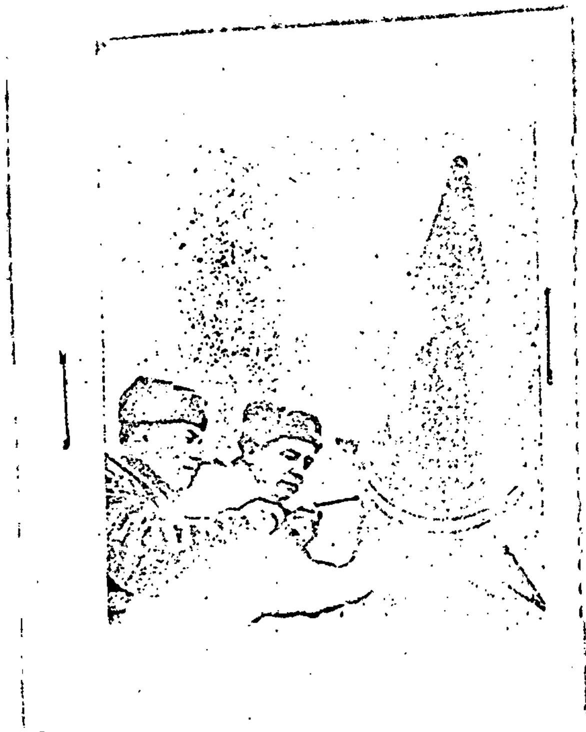
The combat equipment of antiaircraft troops is formidable, but also complex. Because of this complexity, personnel of rocket chasti and podrazdeleniya must daily and persistently train to master their equipment. Feelings of personal responsibility for the defense of the Fatherland are valuable incentives for personnel to master the skills of operating equipment. From such feelings a movement has been started among troops, which uses the slogan, "Knowledge of equipment for every operator." However, many who talk about this phrase do not understand its deeply important connotations. For instance, since it is impossible for soldiers and sergeants during a regular tour of service to reach the level of technical knowledge of personnel who graduate from schools; some commanders propagandize the slogan without truly putting it to practice. They are in error because soldiers and sergeants can be sufficiently trained in the construction and operation of equipment and to quickly repair systemss for launch under any aerial situation.

All rocket podrazdeleniya and operators should be trained in technical work, but such training must be carried on in a strict succession. If some operators fall behind in training, the first care should be that the outstanding operators do not also begin to lag. When all operators of a podrazdeleniye are highly rated specialists, then it can be said that all operators have knowledge of equipment. An example of such a podrazdeleniye is the one in which Officers BRUKMAN, BARAUSOV, and LEONT'YEV serve. The podrazdeleniye's combat activities are outstanding because all personnel have attained a high level of technical training. These personnel were aided in the achievement of this high level technical training through activities of special radio engineering circles, devoted to technical training. These special radio engineering circles give experience in practical technical work and allow observation of system and component interaction. Soldiers and sergeants in the circles also do two-week projects on which they give reports.

Another important condition for raising combat readiness of rocketeers is preventive maintenance. After operators have acquired basic knowledge of equipment components and have mastered the skills of equipment operation, detailed training in preventive maintenance, including periodic and seasonal maintenance, can be carried on. This training gives operators the opportunity for more detailed study of equipment construction and of application of theoretical knowledge to practical operations. In one podrazdeleniye, Officer RUBANOV aids soldiers and sergeants in this training by painstakingly giving advice and recommendations in technical operations and maintenance.

Party and Komsomol organizations are invaluable aids in technical training because they provide examples of leading experience for personnel. In this way, Operators KOSHEVOY and PLYASKIY often appear before assemblies of personnel in order to impart their experience and to demonstrate operational examples; and leading technicians like Comrade LEONT'YEV are able to disseminate suggestions for more effective means of discovering technical defects and of correcting them. Operators VOLKOV, RAZDOBREYEV, and SHERSTYANKIN have achieved outstanding technical evaluations as a result of activities and leadership of the commander, officers, sergeants, and party and Komsomol organizations of their podrazdeleniye.

Experience shows that through skillful organizational work and the mobilization of personnel to successfully execute given assignments, personnel can be trained to successfully complete technical operations, which furthers the increase of combat readiness of rocketeers.



Excerpt:

In the photograph: Officer OSIPOV explains the preventive maintenance procedure to his subordinant FURTSOV.

Tuning and Removal of Defects in Magnetron Generators -- by Engr-Sr Lt V. M. PETROV (Pages 21-24)

Text:

It is often necessary to change the frequency of generated oscillations in magnetrons which operate in defined frequency ranges. This is difficult since it is not easy to distribute tuning elements in given magnetrons. Also, the whole oscillatory system is located in a vacuum. Concerning this, mechanical and electronic methods of tuning are usually used. We will consider each of them and methods of removing defects in magnetrons.

Mechanical tuning consists of resonator parameters changing the direction of these or other organs of adjustment. The induciveness of the resonator system is changed by the direction of the lead-in of the metallic bars in that position of each resonator, where the intensity of the magnetic field reaches maximum magnitude (see Figure 1). Concerning this, it must be considered that the internal wave length of separate resonators changes in intensity in the rod transference, which might be determined by the formula: $\frac{\lambda_o}{\lambda} = a(1-a)\sqrt{1+\frac{h_1 \cdot d_1^2}{h_o(d_o^2-d_1^2)}}$
where $\lambda_o$ is the internal resonator wave length in the absence of a tuning rod; $\lambda$ is the resonator internal wave length in the presence of a tuning rod; $a$ is the emperical coefficient ($a$ = 0.4 to 0.6 ; and $h_1, h_o, d_1, d_o$ are geometric dimensions.

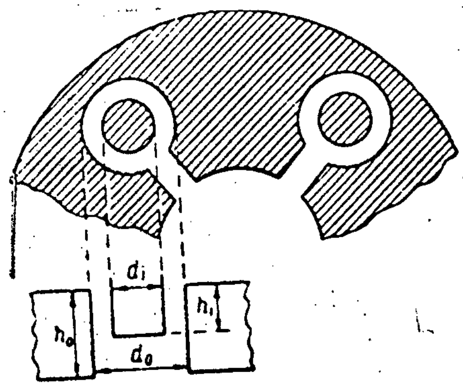


Рис. 1.

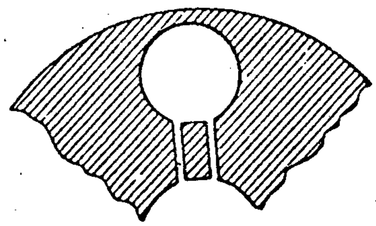


Рис. 2.

Figure 1 Figure 2

Also, the change of the degree of frequency separation of various types of oscillation, which is brought about by such tuning, makes possible resonance of the rods, themselves, which leads to a strong reduction in the efficiency of the magnetron. Change in the capacity is brought about with the aid of a metallic shaft of a special shape, which is switched to that region of the oscillatory system, where the electrical field reaches maximum intensity. If the tuning element is introduced into this field, the capacity of the system and the wave length are increased. If the element is moved away, the capacity and wave length are decreased. Capacity tuning with the aid of rods (a capacity cap) is shown in figure 2. Since the danger od disruption arises in tuning with a capacity cap, this method is utilized with only low-powered, low-voltage magnetrons.

A tuning range, equal to 5 to 10% might be achieved by changing the capacity or the inductiveness. A strong change in quality, in resonance strength, and in efficiency according to range arises and the frequency division of the oscillation shape is deteriorated through a wide spreading of the range. Combined (capacity and inductive) tuning is sometimes used to achieve a large range of tuning. It is best to employ this method in limits of up to 50% for efficiency changes of 10%.

The application of a method, which is significantly simpler in the constructional relation of assymetrical methods and in which the parameters of one of the resonators is changed, is found with examination of symetrical methods. Here, either a special resonator or a piece of coaxial line, which is connected to one of the resonators, serves as a tuning element. The construction of a diapason magnetron with an external resonator is shown in figure 3. To change the frequencies of the magnetron, it is necessary to change the volume of the external resonator with the aid of a flexible diaphragm which forms one of the walls of the resonator. Tuning up to a range of 6 to 7% might be achieved by this method. Substantial shortcomings existing in the assymetrical method of tuning are related to disruption of the angular symmetry of the oscillatory system, which leads to distortion of the high frequency field in the space of interaction and to a reduction of efficiency.

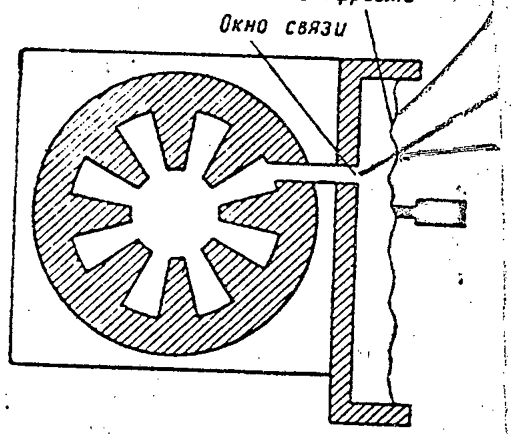


Рис. 3.

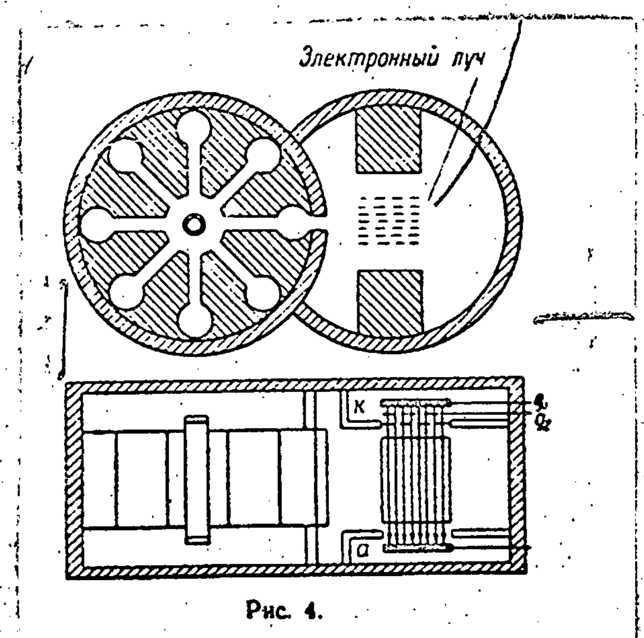
Flexible diaphragm

Connection window

Figure 3

Electronic tuning is accomplished by introduction of an auxiliary electronic current into the oscillatory system in a direction coinciding with the direction of the constant magnetic field, which focuses the auxiliary current into a narrow beam. The last [beam], passing by the interval of the oscillatory system in that space where it has a strong electrical high frequency field, alters the dielectrical permeability of the space. Change of the voltage of the auxiliary electronic current provokes an almost non-inertial change of capacity of the resonator and, consequently, of its natural wavelength.

Electric tuning is discerned by two aspects: internal and external. There is no principal difference between them, but their distinction from each other is that the supplementary electronic current leads into the resonance system of the magnetron in the first case, but into the auxiliary resonator in the second case (figure 4).




'Electron beam

'Figure 4



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It is apparent from the drawing that the electronic current from the auxiliary cathode $K$, accelerated by the grid $g_1$, passes through the current of the resonator and is locked onto the anode $a$. The density of the electronic current is governed by the changing voltage at the control grid. In possible densities of the auxiliary electronic current, changes of the operating wavelengths are only fractions of a percent.

Electronic tuning is accomplished in low power magnetrons by changing the anodic voltage of the magnetron. With this, the resonance system has a low quality owing to the connection of the coaxial lines directly to the segments.

As shown in practice, correct operation of magnetron generators allows constant maintenance of radar equipment in good working condition. The following methods are used for detection of defects.

There is a method of elimination, in which blocks, assemblies, and details, where defects might occur, are eliminated in successive order. There is the method of interjacent changes which presupposes that a transmitting system is composed of a series of components, for example, an antenna and feeder system of a magnetron, a modulator, and a submodulator. If the transmitter does not work, it is necessary to first check for the presence of a trigger pulse at the inlet of the submodulator, of supplied voltage there, of controlled voltage of required amplitude, and of distortion at the grid of the modulator tube; of filiment voltage at the magnetron; and of a modulated impulse at the cathode of the magnetron. It is also necessary to check whether the energy accumulator is charged with sufficient voltage. If the enumerated parameters are within standards and the transmitter does not work, then it is necessary to replace the magnetron.

The third method is the method of replacement of elements of the system, which have evoked doubt of being in good working order.

A search for defects in magnetron transmitters must be carried out in a definite sequence. If the magnetron generates, it is necessary to measure the basic parameters of the magnetron transmitter. In case of significant deviation from the norm, components where abnormal operation leads to deviation, must be checked. Having checked them, it is necessary to consider the blocks and complete a careful external inspection of both the arrangement of tubes and their installation. If the threads of the filaments of the tubes do not light, then a supposition might be made concerning the disrepair of the tubes, themselves.

During external inspection, it is easy to determine the presence of defective radio-details and breaks in the installation. While checking the transmitter, it is necessary to make certain that the voltage power source corresponds to ratings. A search for defects in the components of a magnetron transmitter is best carried out according to a functional chart. Some characteristic defects of magnetron transmitters and recommendations for their removal are considered in the included table:

| Characteristic Defect | Reasons for the Defect | Method for Removing the Defect |
| --- | --- | --- |
| When starting transmitter, time lag relay disk does not rotate. | Contact is lacking in transmitter cabinet interlockings. | Check transmitter cabinet interlockings circuit. |
| | Movement relay in submodulator does not operate. | Check feed relay circuit of movement |
| Operation time of time lag relay exceeds norm. | Defective time lag. | Relpace relay. |
| Fuse in modulator movement circuit burns out. | Spark-over in modulator electronic tubes. | Replace modulator tubes. |
| High voltage not developed. | Break in high voltage circuit control. | Check high voltage circuit control. |
| | High-voltage rectifier fuse spark-over. | Check fuses and replace them. |
| | Voltage phase at high-voltage regulator block not suppressing. | Check circuit voltage while suppressed at high-voltage regulator block. |
| Voltage at high-voltage rectifier does not suppress. | Break in potential regulator saturation coils. | Check saturation coil circuit. |
| | High-voltage rectifier fuses burned out. | Replace fuses. |
| Large high-voltage rectifier voltage, but small current. | Transmitter emission impulse is absent. | Check emission impulse circuit. |
| | Small duration of emitted impulse or of repetition frequency. | Check duration of emission impulse and of repetition frequency. |
| Large high-voltage rectifier current, insufficient high voltage. | Movement voltage absent at modulator. | Check movement voltage at modulator. |
| | Magnetron has gone out of order. Power accumulator breached. Modulator tubes out of order. | Replace element which has gone out of order. |



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| Characteristic Defect | Reasons for the Defect | Method for Removing the Defect |
|---|---|---|
| Noises of intermediate-frequency amplifier on indicator screen, but not "its" impulse. | Transmitter emitted impulse not suppressed. | Check transmitter impulse emission circuit. |
| | Submodulator master oscillerator not operating | Check master oscillerator regime and replace tube in cases of disturbance. |
| | Modulator tubes out of order. Power accumulator breached. Magnetron defective. | Replace element which has gone out of order. |



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With low power output of a magnetron generator, it is necessary to check: the coefficient of the standing wave of the antenna and feeder system, the voltage of the magnetron filament, the anodic voltage of the magnetron, and the coefficient of magnetization of the magnet. If these parameters are within the norm, the low level of power output is explained by a defect in the magnetron which must be replaced.

The frequency spectrum of the high-frequency impulse is an important indicator as it is characterized by the operation of the magnetron transmitter. Many conclusions can be drawn concerning the operation of the magnetron transmitter, by observation of the spectrum. If the transmitter is operating normally, its spectrum approximates the spectrum of an ideal, high-frequency impulse with a rectangular envelope. From practice, it is known that strong distortion of the high-frequency impulse spectrum occurs as a result of a significant deviation of the modulated voltage from a rectangular shape.

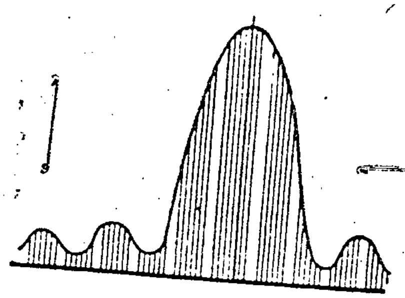

Рис. 5.

Figure 5.

With the presence of misfiring, the spectrum of the high-frequency impulse is "faulty" as one or a few lines precipitate out of it (figure 5). Such a phenomenon is explained by insufficient amplitude of the output impulse of the submodulator, great intensity of movement voltage at the modulator tube circuit, and a steep front of the modulator impulse.

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Alteration of the aspect of the oscillation, which is generated by the magnetron, might be measured by examing the shape of the magnetron impulse current, which in this case has a pulsated summit or plateau (figure 6). Generation of undesirable aspects of oscillation by the magnetron results from the poor shape of modulated voltage. Significant change of the frequency of the magnetron generator as a result of inconstancy of external load, fluxuation of external temperature, change of the regime of the magnetron generator feed, and also deterioration of the shape of the modulated impulse are observed.

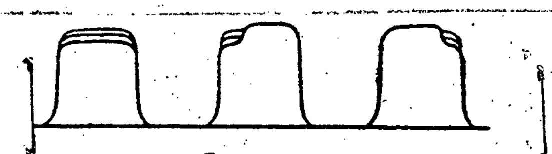

Рис. 6.

Figure 6.

Sparking of the magnetron generator might often be observed in its operation. This limits both the extent of maximum current, which may be taken from the cathode in a given duration of impulse, and the permissible value of the duration of the impulse in a given current of the magnetron. The appearance of sparking is revealed by sharp deflections of the instrument needle which is controlled by the average current of the magnetron. Frequent sparking comes from excessive density of current in any part of the cathode or too great an electric field intensity at its surface; from a sharp change in the magnetron operation regime; from a decreased emissive capability of the cathode resulting from a protracted period of magnetron operation; and in new magnetrons, from a defective filament and weak magnetic field.

Since strong magnetron sparking usually is observed during the initial period of operation, the generator will have to be aged to remove it [sparking].

Knowledge of the essentials of these phenomena by personnel, who operate magnetron transmitters, will aid in the rapid location and removal of defects in the apparatus. This, in turn, improves the quality of preventive maintenance and keeps equipment in constant combat readiness.

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Methods of Studying Sawtooth Voltage Generators -- by Engr-Maj A. I. KANAVO and Engr-Maj B. A. KOTOV (Pages 25-29)

Text:

A two-hour period of study of sawtooth voltage generators is being conducted in a class where diagrams, posters, and working models are distributed As shown by experience, in the investigation of themes, it is most expedient to observe the following procedure in the use of materials.

Introduction. Before going into a consideration of the possible systems of sawtooth voltage generators, the purpose and principle of their formation must be dwelt upon.

It is known that generators of line variable sawtooth voltage have found wide usage in various radar equipment. Such voltage is used to form the various types of electronic beams for scanning indicators with electrostatic and electromagnetic systems of deflection and also in electronic computers. Charged or uncharged capacitors are used to obtain line variable voltage.

The problem of generating line sawtooth impulses boils down to obtaining a constant charged or uncharged capacitor current $(i = i_0 = const)$. In obtaining this condition of voltage at the capacitor, the initial level is changed according to the law $\Delta U_c = \frac{i_0}{C} t$. This indicates that with stability of the charged (uncharged) current, a change of voltage at the capacitor comes about according to linear law, i.e., proportional to time $t$.

The principle of obtaining sawtooth voltage might be shown by the diagram in figure 1.

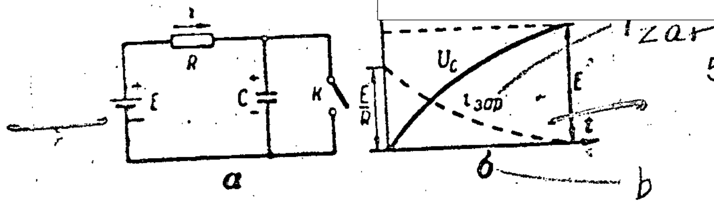


Рис. 1. Принципы формирования пилообразного напряжения.

Figure 1. Principles of forming sawtooth voltage.

At the moment the key $K$ closes, the voltage at the capacitor $C(U_c)$ equals zero. The current $i = i_0 \frac{E}{R}$ flows through resistance $R$. When the key is opened the charged current $i_{zar}$ flows through the capacitor and the current at the capacitor begins to increase, attempting to reach the voltage level of the source $E$.. With the closing of the key, a quick charge of the capacitor is begun and the system goes back to its original condition.

In actual systems, the role of the key is filled by an electronic tube. The resistance of such a closed electronic "key" does not equal zero, and therefore in the original state voltage at the capacitor will be $U_{co}$.

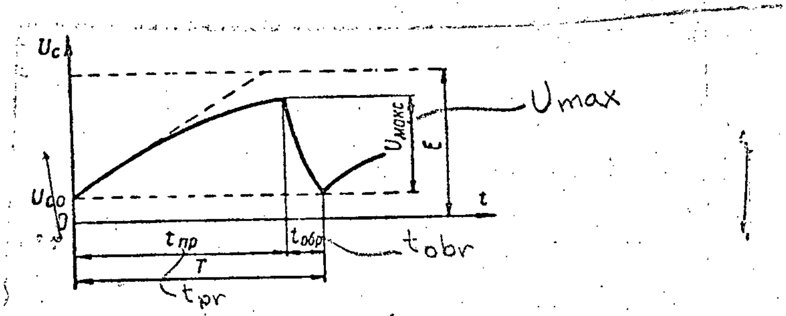


Рис. 2. Параметры пилообразных импульсов.

Figure 2. Sawtooth pulse parameters

Let us consider the basic parameters of sawtooth impulses (figure 2). Considering them: the period of sawtooth voltage impulse repetition $(T)$; straight line movement duration $(t_{pr})$ defined as the operation region in which the voltage must be changed according to linear law; the duration of return movement $(t_{obr})$, i.e., the time for restoration to the

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original condition of the arrangement ($t_{obr}$ is always $\ll t_{pr}$); amplitude of linear changed voltage ($U$ max), which characterizes the voltage increase at the capacitor during the time of straight line movement; the coefficient of nonlinear voltage $a_0 = \frac{i_{nach} - i_{kon}}{i_{nach}}$, where $i_{nach}$ and $i_{kon}$ are charged currents in correlation to the beginning and end of straight line movement. The leader of the [training] activity must remind [personnel] of the concrete meanings of magnitudes for periods of synchronized impulse repetition (tpovt) and of the connection of the period to frequency $f_{povt} = \frac{1}{T_{povt}}$.

It is evident from the drawings that nonlinear sawtooth voltage leads to non-uniform speeds of electronic beam movement on the indicator screen. If nonlinear sawtooth voltage is applied for the formation of evolvements of distance, then this might evoke mistakes in the determination of true distance values. In order that this will not happen, special measures are usually employed, which facilitate obtaining voltage which has been changed during the time of straight line travel according to a law very like the linear law.

Sawtooth voltage generator systems: The following systems are widely used in radiotechnical equipment: the sawtooth voltage generator with active resistance in the charged circuit; the sawtooth voltage generator with a pentode tube in the charged (uncharged) circuit; line rising voltage generator with a positive return connection; and line falling voltage generator with negative return connection.

The simplest sawtooth voltage generator system with active resistance in the charged circuit is shown in figure 3.

When the tubes are not negatively charged at the control grid, it is open and the voltage at its anode is small; so resistance $R_i$ is great and

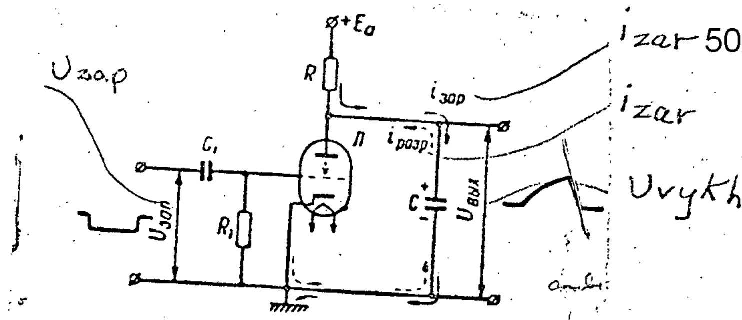


Рис. 3.

Figure 3.

almost all source voltage $E_a$ (80-90%) falls on it. In this case, the voltage at the capacitor is equal to the voltage at the anode. As is evident, tubes act as closed keys in such a situation (See figure 1).

With the introduction of a rectangular impulse of negative polarity at the control grid, the tube closes and the current in it is stopped. This situation correlates to an open key. Through resistance $R$, the capacitor begins to be charged and the voltage in it increases according to exponential law (straight line movement). With stoppage of the impulse, the tube is again opened which is equivalent to closing the key. Voltage at the anode is sharply stepped down and the capacitor is quickly charged through the tube to the original level.

With the periodic admission of impulses of negative polarity at the tube grid, repeated impulses of sawtooth shape are formed at the generator outlet.

Let us consider the influence of the elements of the system on the sawtooth voltage parameters. The speeds of voltage accumulation (charge) at the capacitor and also its discharge depend upon constant time of circuit charge $(RC = t)$ and discharge of this capacitor. By determining the meaning of $E_a$, the more $t$, the greater the time necessary for the voltage at the capacitor to be changed to one and the same intensity. The dependence of the speed of voltage accumulation at the capacitor on constant time is shown in figure 4.

With a given capacitor capacity, the speed of charge depends on resistance $R$, and the speed of discharge depends on the internal resistance of the open tube, which consists of a few hundred ohms. In practice, the speed of charge is regulated by the change of capacitor capacity or resistance. The greater the capacity, the more quickly the capacitor is charged, i.e., voltage increases in accordance with the brevity of the time interval.

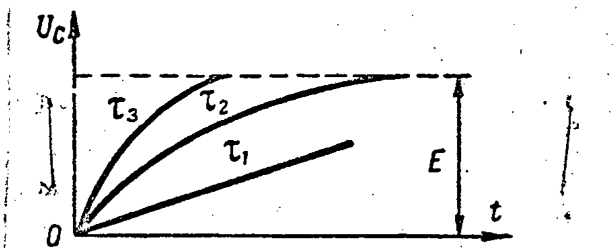


Рис. 4.

Figure 4

The amplitude of sawtooth voltage depends on intensity $E_a$ and the duration of the impulses which are conducted to the tube grid. The greater the intensity $E_a$, the greater the amplitude of sawtooth voltage. With the small duration of capacitor impulses, the source is not successfully charged to full voltage, therefore the amplitude is small.

The advantage of the arrangement under consideration is in its simplicity and short return motion time. However, it has inherent shortcomings. The formed sawtooth voltage can be considered linear only at the initial exponential section. Therefore, large amplitudes of voltage cannot be achieved with a small coefficient of non-linearity.



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The specified arrangement is used only in those radar apparatus which do not require linear envolvement and also in those cases where the small achieved linear voltage is necessary for great intensification (for instance, in oscillographs).

To make certain of the reception of the studied material, the leader of the study points out the outlets on a working model of a generator. The advantages and disadvantages of the system are shown on the screen of an oscillograph, as is the influence of adjustment on voltage parameters.

What is the purpose of a sawtooth voltage generator with a pentode in the charged (uncharged) circuit? It was said earlier that an important condition of achieved linearity of sawtooth voltage appears to be stability during the time of current charge (discharge). In order to stabilize it in the generator system, the pentode is opened (figure 5). The dependence of the anodic pentode current on the anode voltage is shown in figure 6. If the voltage amplitude $U_a > U_a^{min}$, than with change of anodic voltage, the tube current is very insignificantly changed, so that the pentode shows resistance to variable current on the order of 1 Megohm.

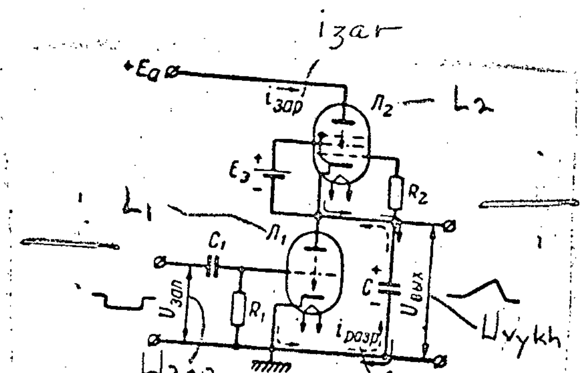

Рис. 5.

Figure 5

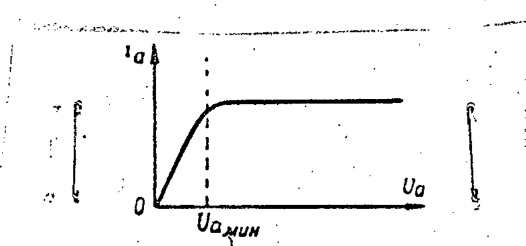

Рис. 6.

Figure 6

In such a manner, during capacitor charge through the pentode, the charged current remains practically invariable, and voltage at the capacitor is changed according to a law which approximates the linear law. In order to improve the linearity of the operating region of sawtooth voltage, special systems called "linearity-controls" are used.

The arrangement, shown in figure 5, works like the one shown in figure 3. The difference is that in place of active resistance, the pentode $L2$ is open. In the absence of a negative impulse, both tubes, the charged $L1$ and the pentode $L2$ are opened. With the introduction of a cut off impulse, the tube $L1$ is closed and the capacitor is charged by the charged current and by the stabilized pentode.

The pentode arrangement allows the achievement of a small coefficient of non-linearity (on the order of one percent) with sufficient voltage amplitude. These systems have been employed in measuring apparatus and in some radar display systems.

Besides generators of linear increasing voltage, which is initiated by impulses of negative polarity, there are systems for achieving linear decreasing voltage which use the linear charge of capacitors and the initiated impulses of positive polarity.

Usage of sawtooth voltage generators with a pentode in the charged circuit has shown that the pentode is not an ideal stabilizer. Significantly better results may be ahcieved if a return connection is introduced into the system. In this case, automatic regulating by the strength of the charged current is realized.

In linear control systems both positive and negative return connection is used. Let us consider the principles of operation of such systems.



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A condition of continuity of the charged current might be maintained if the source feed voltage increase is provided in conformance with voltage increase at the capacitor. This may be achieved in the system by a positive return connection.

Arrangements of linear increase voltage generators with positive return connection (figure 7) are often met with in practice. The generator opens: the charged tube $L_1$, the cathode repeater $L_2$, the diode $L_3$, and capacitors $C$ $C_2$ $(C_2 \gg C)$

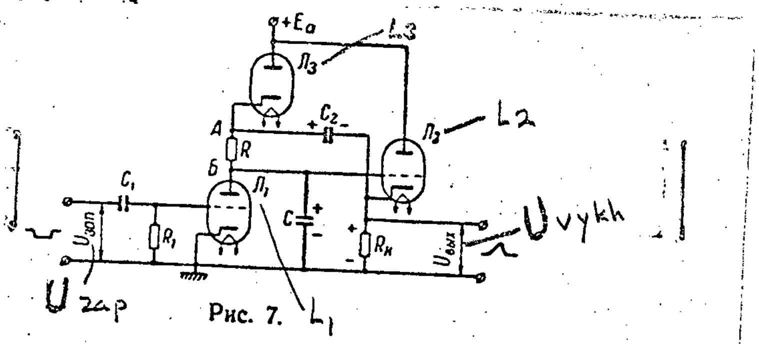

Рис. 7.

Drawing 7

In the original condition, tubes $L_1$, $L_2$, and $L_3$ are open. The principal part of the source voltage decreases at resistance $R$. Thus, it is selected more significantly by the internal resistance of tube $L_1$. Capacitor $C$ is charged to the small voltage $U_{c0}$, for equal decrease of voltage at tube $L_1$. The current, which flows through tube $L_2$ creates decrease of voltage $U_{RK}$ at cathode resistance $R_K$. The capacitor $C_2$ is charged to $U_{c2} = E_a - U_{RK}$. The insignificant voltage decrease at diode is not considered in this.

At the moment of introduction of a negative emitted impulse, tube $L_1$ is closed. With the current, which is created successively with the source openings of voltage $U_{c2}$ and $U_{RK}$, a supplementary charge of capacitor $C$ through resistance $R$ is begun.

The action of positive return connection consists of the following. With increased voltage at capacitor $C$, the anodic current of tube $L2$ increases, which leads to increase of the emitted voltage $U_{KK}$.

This voltage through capacitor $C_2$ and resistance $R$ will be transmitted to the grid of tube $L2$, which in its turn leads to still greater increase of the emitted voltage of the cathode repeater. With charge of capacitor $C$, the potential of point $b$ increases, as at point $A$. As a result, diode $L3$ is closed. This leads to the very beginning of straight line travel. The charged current, which is flowing through resistance $R$, will be constant, thus increasing voltage $U_5$ thanks to the cathode repeater practically evoking that change of voltage $U_{KK}$, and consequently, increasing the potential of point $A$. Diode $L2$ insures the required increase of potential at point $A$. Upon termination of the action of the emitted impulse, tube $L1$ is opened, capacitor $C$ is discharged and the systems returns to its original condition.

An advantage of the considered generator is that it ensures a small coefficient of non-linearity (one percent). The sawtooth voltage is taken from the cathode repeater, of which the emitted resistance is low, which is often required for concordance with following cascades. The given generator system has found wide use in radar indicator systems.

Figure 8

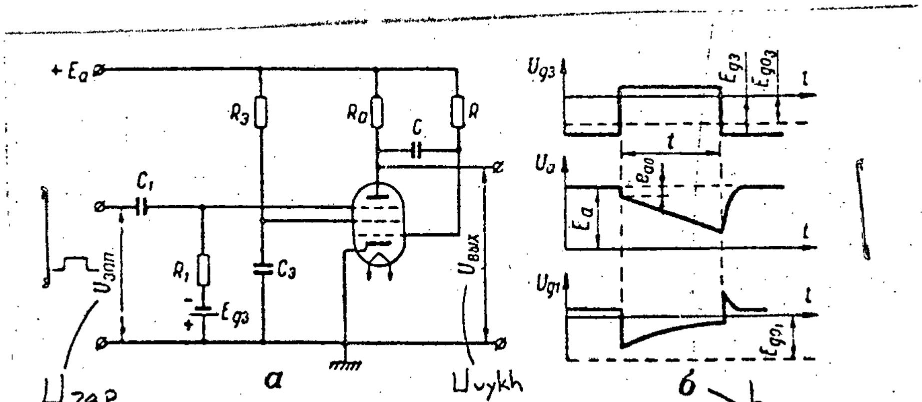

Рис. 8.

In the generator system of linear decreasing voltage with negative return connection (figure 8a) in distinction from that previously considered, a stabilization of discharged current is brought about. The action of this return connection can be most simply shown on a generator system in which a return connection exists through the condenser, which is open between the anode and the tube grid. This connection is negative. So, with increase of voltage at the grid, voltage at the anode is decreased. Through capacitor $C$ it is transmitted to the control grid and evokes a return action, i.e., increase of voltage at the anode.

How does a generator, which is constructed in this manner, operate? In order to understand the essence of this question, it is necessary to quickly consider the voltage diagrams (figure 8b).

Until introduction of a closed impulse, the tube is closed according to the anodic displacement of current $E_{g3}$ at the protective grid. The potential of the control grid is positive and close to zero because the basic part of the voltage $E_a$ decreases at resistance $R$. Thus, resistance of the grid region or cathode of the open tube is small. Condenser $C$ is charged approximately according to source voltage of anodic feed $E_a$. Almost all of the tube cathode current goes to the circuit of the screen grid.

The generator is started by the positive impulse which has been conveyed to the protective grid. The tube is opened along the anodic current. The negative jump of voltage at anode $e_{ao}$ through the capacitor is transmitted to the control grid. Consequently, the negative return connection, which is of the intensity of this drop, can not exceed the tube closing voltage along the control grid. Thus, the tube cannot close itself. Discharge (overcharge) of the capacitor is begun through the capacitor and tube. Voltage at the anode drops according to the capacitor charge and the charge tends to fall, but this leads to raising the voltage at the control grid. The negative return connection stabilizes the charged current. This is explained by the following example.

Suppose that for some reason, the capacitor charge flow has been decreased. Then the decrease of voltage at resistance R is also decreased and the control grid potential is increased which evokes a conforming increase of anodic current, and consequently, of charged [current?]. In this way, charge flow is maintained exemplarly constant and voltage at the capacitor is changed according to a law which approximates linear [law].

At the moment of completion of the emitted impulse, the tube is closed along the anodic current and the capacitor is charged through the resistance and the grid-cathode region. The system returns to its original condition.

Advantages of the given generator are simplicity of construction (It operates on one tube) and a small coefficient of non-linearity (on the order of ten percentage units). The shortcomings of the arrangement are comparitively large amplitude of closed impulse, so that control is employed along the protective grid, and the significant time of return travel.

Generators of linear change voltage are widely used in radar apparatuses and are an integral part of systems for impulse delay as in the phantastron.

For the best mastery of the studied material, it is expedient to assign two or three check questions after the explanation of each system. After satisfactory answers have been received, then go to the explanation of the next assignment.

Finally, it is the responsibility of the leader to draw short conclusions, to answer questions, and to indicate literature which should be used. For example: B. Kh. KRIVITSKIY "Impulse Systems and Arrangements," V. V. NELEPETS and V. S. NELEPETS "Impulse Regimes in Radiotechnical Circuits," N. P. SHIRYAYEV "Generators of Non-sinusoidal Oscillations," and Ye. A. KATKOV and G. S. KROMIN "Fundamental Radiotechnical Technology" part II."

A Simple and Convenient Graph (Page 29)

Text:

During combat operations, commanders need to determine time intervals between targets according to the formula:

$$\Delta t = \frac{\Delta D}{V}$$

where $\Delta D$ is the distance between targets;

$V$ is the speed of the target.

This requires a comparatively long period of time and also can result in computation errors.

Maj S. D. LEVIN has suggested a graph (see diagram) which lightens a commander's work considerably. The moment $\Delta t$ can be determined to within one second with the aid of the graph. Also, the moment $\Delta D$ can be interpolated by means of the graph to within the limits of the series of curves.

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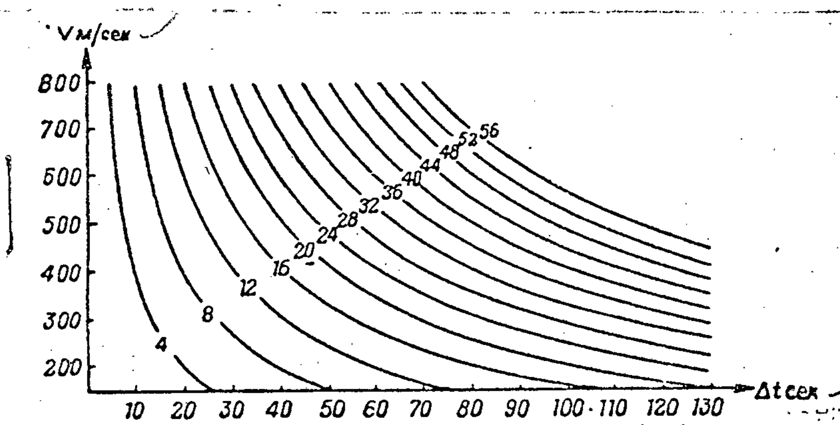


Δt sek

'Bloodhound' Rocket -- by Engr-Lt Col Ye. A. PAVLOV, Candidate of Technical Sciences (Pages 30-33)

Abstract:

Information taken from the following press sources: Flight, No 2641, 1959 and Missiles and Rockets, No 7, 1960. Gives a complete description of the "Bloodhound" ground-to-air missile, its components, and its operation. Three drawings show: 1. three views of the missile component arrangement; 2. ejection of the solid fuel rocket engine pac from the missile; and 3. a cross-section view of the ram-jet engine of the missile. The article states that the "Bloodhound" is one of the basic parts of the antiair defense of the British Air Force.

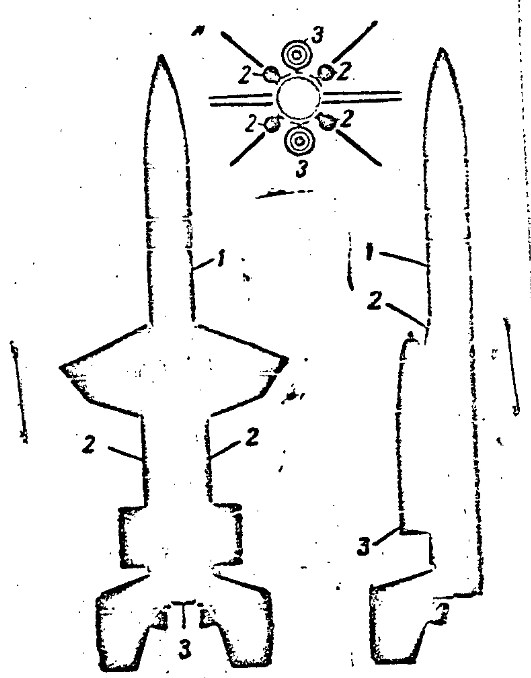


Рис. 1. Устройство крылатой управляемой ракеты «Бладхаунд»:
1 — корпус; 2 — стартовые РДТТ; 3 — сверхзвуковые прямоточные воздушно-реактивные двигатели (СПВРД).

1

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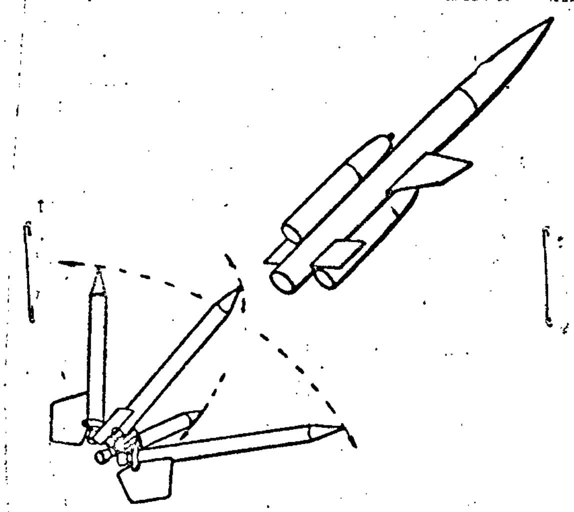

Рис. 2.

3

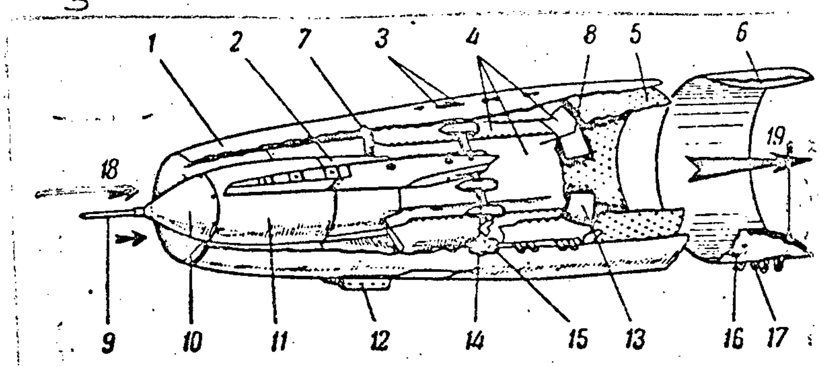


Рис. 3. СПВРД в разрезе:

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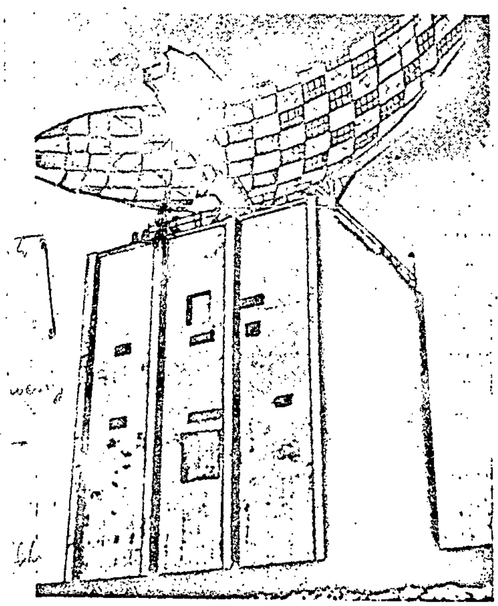
"Codephase System (Page 33)

Text:

The American firm Sylvania Products is testing a radar system based on methods of electronic scanning. This system appears to be intended for the creation of a radar which will be used in antiair defense. Receiving systems with electronic scanning use a multitude of separate antenna elements and an unusual parabolic reflector. They allow the scanning speed to be increased to millionths of a second as opposed to tenths of a second with antenna which are mechanically driven.

The experimental system has been designated "Codephase" (Coherent cipher system with electronic scanning). New methods of processing signals and forming beams are employed in it, which make the system capable of simultaneous target detection and tracking, and range determination with improved precision.

For processing of echo signals and field of vision control, a cipher calculation and determination device is employed in the system.



## Fighter Aviation

### High Tactical Training for Fighter Pilots (Pages 34-38)

Summary:

Because tactical training is necessary for success in aerial combat, chasti and podrazdeleniya of antiair defense are carrying on extensive training to train pilots in theories and practices of aerial combat. Exemplary aerial combat training is carried out in the squadron commanded by Maj BOCHKOV, pilot first class. Because the thorough training conducted in this squadron closely approximates combat conditions, pilots of this squadron can reliably intercept aerial targets in any weather conditions, day or night.

Ground school is an important aspect of aerial combat training, but it must be coordinated with prospective flight assignments and it must not be carried on sporadically. In some podrazdeleniya, tactical training is not of high quality. Sometimes, it is carried on without imagination or interest, without wide usage of characteristic examples from flight training experiences. This occurs because of lax training leadership or because officers without sufficient flight experience are sometimes assigned to lead combat training.

Other important forms of tactical training are tactical teams and group practice. However, some commanders do not attempt these forms of training because they are afraid of the complexity of preparing for them.

The most important phase of tactical training is actual flight training. This is where pilots learn how to take initiative, how to act independently, and how to think according to combat tactics. These objectives can not be properly met unless commanders are careful to vary

the combat situations used in flight training. Pilots must be trained in conditions where their aerial targets change altitude, course, and speed. Pilots also should not have prior knowledge of the course of aerial targets, but should be trained to follow the instructions of the flight controller who, in turn, should not deprive pilots of initiative or choice of tactical method of interception.

Firm objective post training flight evaluations are also necessary for proper tactical training. Photographic results obtained by use of gun cameras are extremely valuable aids for objective evaluation, but they must be used in greater volume than they are at present and they must be interpreted with the aid of experienced pilots in order to develop understanding of such factors as maneuvering for attacking positions."

Excerpt:

It is well known that an aerial enemy will not act in a routine fashion. Besides maneuvering, he will certainly use all of his fire power to break off a fighter attack. This is not always taken into account in aerial combat training. Ordinarily, pilots, instead of energetically and quickly attacking aerial targets, sluggishly maneuver to a point behind the target and, in full view of the 'enemy' and within range of his weapons, peacefully take a few pictures with their gun cameras. The films are developed, and if a pilot has accurately photographed the target, he receives a high evaluation for the exercise. There is no need to point out that such practice is not in the best interest of training skilled pilots. A commander must train pilots for aerial combat with firm, technical knowledge of an enemy.

(Two captioned photographs by I. RYBIN show Capt V. PRIVALOV, pilot; and Sr Lt P. POLTAVCHUK, fighter pilot.)

Organization and Execution of Weather Reconnaissance -- Col V. M. BIBIK, pilot first class, (Pages 39-41)

Abstract:

This article describes the proper method for carrying out weather reconnaissance flights and also describes functions of commanders, flight controllers, and weather forecasters in connection with weather reconnaissance flights. The article states that, prior to a weather reconconaissance flight, the following should be considered: pressure systems, frontal activity, icing zones, cloud cover and altitude, storms, fog, etc. The purpose of a weather reconnaissance flight, according to the article, is to determine and transmit data concerning: visability, cloud altitude and stratification, precipitation, regions of storm activity, air thermal intensity, and zones of fog and haze.

Strict Observance of Preflight Regimen -- by Capt Med Serv V. A. PONOMARENKO (Pages 42-43)

Abstract:

This article states that strict observance of preflight diet and rest regimen of pilots is necessary for the health, professional growth, and combat readiness of podrazdeleniya and chasti. The following examples are given of the consequences of the failure to observe preflight regimens:

Capt IVANOV had to abort a night exercise and return to base because he became ill at an altitude of 11,000 meters after a heavy meal;

Sr Lt SUKHOPAROV overshot the runway during a landing because he was tired after an extended period of improper rest habits; Maj KOLPYSHEV developed an ulcer, through improper eating habits which was aggravated by changes in pressure; and Sr Lt PUKHNYY was grounded after he developed vestibular difficulties which were brought on as a consequence of continued flying with a head cold.

[A captioned photograph by Z. SORKIN shows Capt L. SHAPKOV, Pilot 2nd Class, preparing to take off on an interception exercise. (Page 43)]

Control of US Antiair Defense -- by Lt Col I. V. MIKHALEVSKIY and Maj M. V. SHUL'GA (Pages 44-46)

Abstract:

This article, based on material from the foreign press, presents analysis of the control, organization, and operation of the North American air defense. Explanations are given of the "Sage, "Mantrac," and Missile Master" systems; and of the operation of "Bomarc", "Nike-Ajax," and "Nike-Hercules" missiles. Foreign press sources used for the article were: <u>Aircraft</u>, December 1960; <u>Army Information Digest</u>, March 1961; <u>Aviation Week</u>, April 1960; <u>The Aeroplane</u>, December 1959; and <u>Interavia Air Letter</u>, No 4343, 1959

## <u>Radiotechnical Troops</u>

<u>Careful Training of Officer Cadres</u> -- by Col O. S. KUPRIYANOV (Pages 47-50)

Summary:

The 22d Congress CPSU concluded that it is necessary for all Soviet Command personnel to master Marxist-Leninist theory, to have high military technical training, to answer all requirements of contemporary military

science and activity, and to strengthen military discipline. This conclusion pertains to officers of radiotechnical troops, who are responsible for maintaining the continual combat readiness of radar podrazdeleniya which are often required to serve under difficult conditions.

Young officers, who arrive in chasti and podrazdeleniya of the radiotechnical troops following graduation from school, lack experience. When they are assigned to posts of responsibility, they must not only train their subordinates, they must themselves be trained. Their training is the responsibility of commanders, political workers, staffs, political organs, and Party and Komsomol organizations. The results of the work of Officers SAPUNOV, OSIPOV, BELYANSKIY, ALISOV, DEGTYAR", TSYBUL"SKIY, LOMADZE, ANDRIANOV, TSYMBAL, VORONOV, PEREVERZEV, and others has shown that where close attention is paid to maintaining a high level of combat and political training, personnel are able to fulfill the demands of combat readiness and discipline. In apposition to the fine work of the abovementioned officers, there are some individuals, like Officers LUKOV and KULAZHENKO, who have insufficient technical knowledge and consequently are unable to properly train subordinates. It is not only necessary to constantly train young officers; the rapid pace of technological changes demands that all officers be continually trained.

An important part of training highly qualified specialists in the radiotechnical troops is the close cooperation between chasti and podrazdeleniya and military schools. Students and officer candidates should be assigned to positions of responsibility during periods of practical training, where they can work with experienced personnel in resolving technical problems. Also, objective evaluations of the work of these students and officer candidates should be forwarded to their schools, but many commanders do not do this.

A basic part of increasing the military technical knowledge of officers is individual study. This study should be well planned and under the control of senior officers who are able to give assistance when it is required. Other independent study aid include technical circles and talks by experienced personnel. Of course, all officers should constantly be acquainted with new technical literature so that they can learn of developments in radar equipment both in their own and foreign countries.

The technical knowledge of our officers must continually grow. The ranks of highly qualified specialists must constantly be increased.

( (A captioned photograph by A. LUKERCHIKA shows Lt A KUZ'MENKO and Sr Master Jr Sgt V. DEMENT'YEV repairing a radar component.

Level Comparison Systems -- by Engr-Sr Lt Yu. A. POGULYAYEV (Pages 51-53)

Text:

Level comparison systems are encountered rather often in pulse work. They are used primarily as variable pulse time delay circuits and have a broad range of time delay changes. For instance, a phantastron system might provide a delay on the order of a tenth of a millisecond, but a level comparison system might provide a delay on the order of ten milliseconds. This system is used in simulation apparatus as an assigned condition of simulated signals, and also in devices which transform amplitude modulation of slowly changing voltage to time impulse modulation.

Operation of an ideal system is reflected in the voltage diagram, depicted in figure 1. Sawtooth voltage U pily (figure 1,à) is supplied to the comparison level system by a special generator. Duration of the straight line travel of the saw teeth determines the range of the time delay change. Constant or slowly changing voltage Upost also enters from a special exterior source. Its intensity determines the pulse comparison situation at the proper time. The curve (figure 1,b) reflects the character of anodic voltage change at one of the tubes of the system. The voltage is differentiated (figure 1,b) and emitted through the diode at the outlet of the system. In this way, only pulses which correlate to the comparison with the straight line travel of the sawteeth will be at the outlet.

Let us examine the principle of operation of a level comparison system (Figure 2.) Sawtooth voltage is supplied to tube grid L1 and slowly changing voltage from an external source is supplied to grid L2. A system equivalent to this consists of a voltage source and output resistance Ruykh.

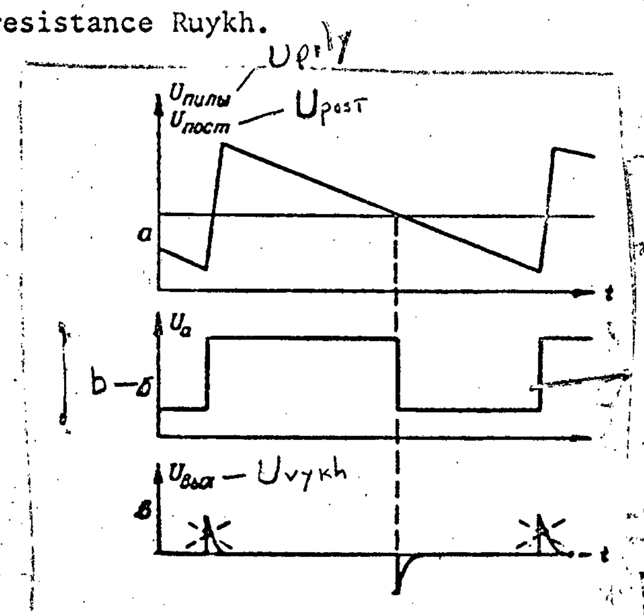



Рис. 1.

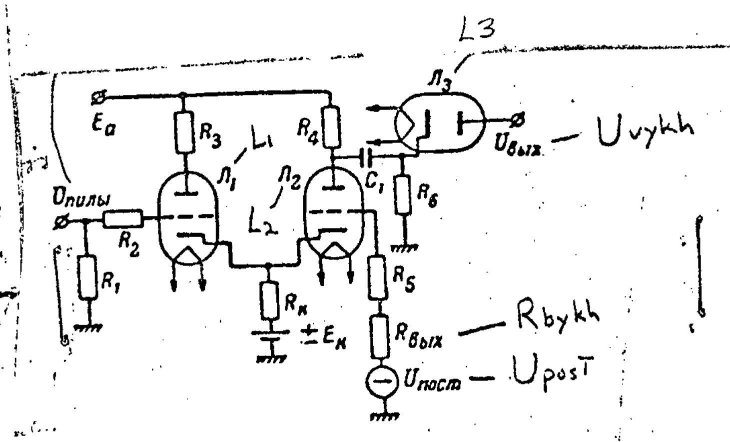



Рис. 2.

Figure 1.

Figure 2.

For the selection of tube quiescent points in the circuit they [the tubes] are supplied an auxiliary grid bias $E_k$. The grid voltage of tubes $L_1$ and $L_2$ is dissimilar. And although the tubes have common cathodic load, distortion in the cathode circuit, anodic feed [symbol not reproduced on copy] and identical anodic loads; the electric condition of the tubes will not be identical.

The system works in the following manner. With alteration of the direct travel of the saw teeth in a range of 1-2 (figure 3), voltage at the grid of the open tube $L_1$ is significantly larger than voltage at the grid of the closed tube $L_2$. During this period, voltage $U_{gl_2k}$ according to absolute intensity is greater than cut off voltage; tube $L_1$ works as a cathodic repeater, i.e., $U_k \approx U_{gl_1}$ (the dotted line on the diagram, figure 3,a).

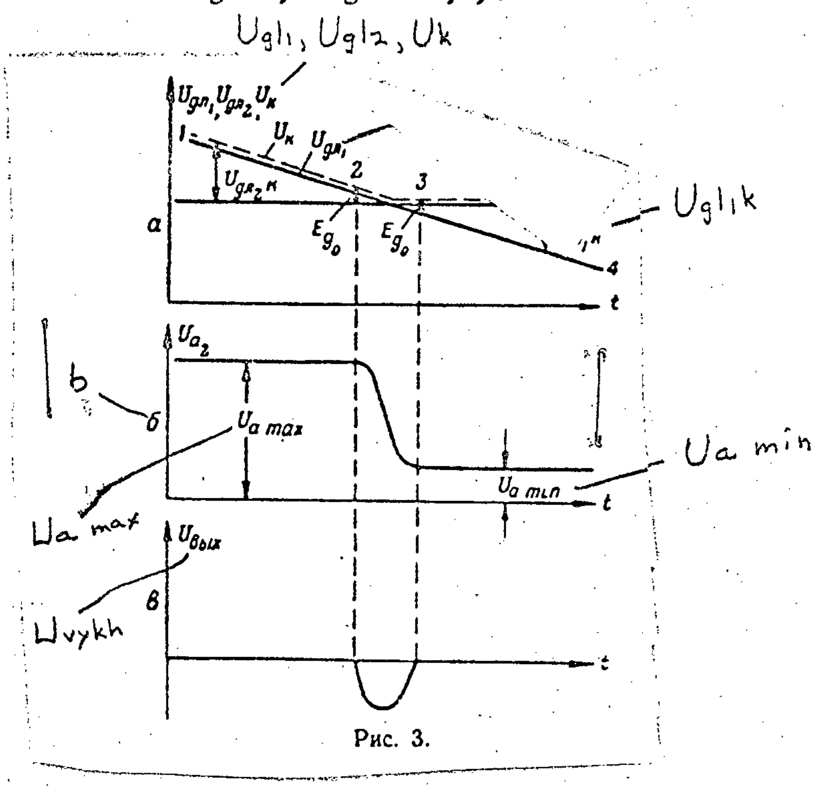


Рис. 3.

Figure 3.

With the furthermost reduction of sawtooth voltage, the voltage between tube grid $L_2$ and cathode $U_{gl_2k}$ becomes similar, and therefore smaller in absolute intensity $E_g$, (point 2 on the diagram). As soon as $U_{gl_2k} = E_{go}$, tube $L_2$ is opened slightly, but tube $L_1$ is still opened. Such a condition continues until point 3, when $U_{gl_1k} = E_{go}$, i.e., until that time when tube $L_1$ is completely closed. The slow overturning of the system, i.e., the closing of tube $L_1$ and the opening of tube $L_2$, causes the conditions for a sloping drop of voltage at tube anode $L_2$ (figure 3,b). The comparison impulse, which has been achieved as a result of the differentiation of the sloping drop of the cell $C_1R_6$ (figure 2, appears diffused with absent expressions of forward and rear fronts. Therefore, this system is seldom encountered in practice.

The system, shown in figure 4, has found wide usage. It differs from the former one only in the presence of a connection between the anode of tube $L_1$ and its grid through the capacitor $C_1$, between the anode of tube $L_1$ and the grid of the second tube through the capacitor $C_2$, and also the presence of a diode $L_4$, which is constantly parallel to grid resistance $R_5$.

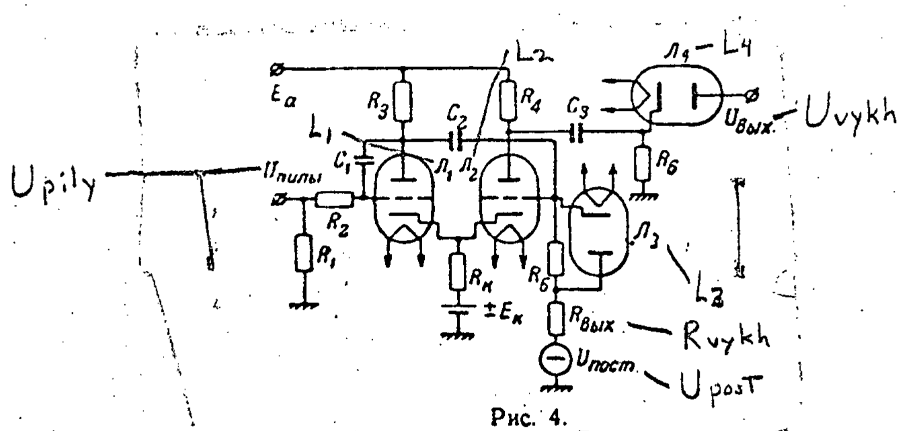



Figure 4.

"Let us consider the operation of the system with direct travel of sawtooth voltage (figure 5). The presence of the capacitor $C_2$ introduces principal changes in the operation of the level comparison system and in many cases allows the time for overturning of the system to be shortened and increases the precision of its operation. As soon as voltage $Ugl_2k$ becomes similar, and therefore Egosmaller, tube $L_2$ is opened slightly and the current, which flows through it, creates a voltage drop at cathods load Rk, which is applied to advantage to tube cathodes. Tube L1 was completely opened until this time, voltage at its anode compared to Ua min, and capacitor $C_2$ was charged according to the intensity of voltage $Uc_2$ = Ua min-Upost. The positive voltage, which was applied to the tube cathode L1, additionally closes tube L1, voltage at its anode increases, and capacitor $C_2$ begins to be additionally charged. The current of the additionally charged capacitor travels along the following circuit: the anodic feed source Ea-$R_3$-$C_2$-$R_5$-Rvykh of the source of constant or slowly changing voltage, ground, anodic feed source. A voltage drop is created at resistance $R_5$. By it application to the tube grid $L_2$, the tube is opened more, the current flowing through it is increased, etc. Thus so-called avalanche process develops where $L_2$ is practically instantaneously opened and L1 is closed. The voltage jump at grid $L_2$, which is created by the current of the completely charged capacitor $C_2$, leads to the development of voltage at the cathodic load Rk and a negative voltage drop at tube anode $L_2$, which is differentiated from cell $C_3R_6$. A negative three-cornered impulse with a sharply defined forward front is received at the outlet of the system.

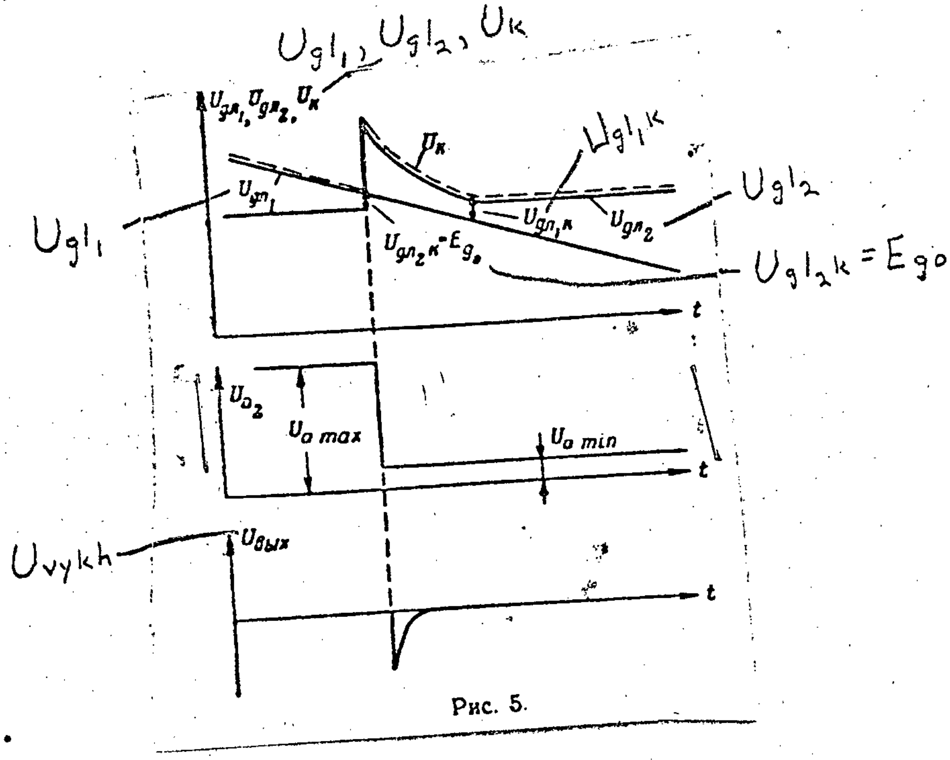



Figure 5.

"From the moment when the tube $L_1$ is fully closed, the current of the capacitor charge $C_2$ no longer increases. In proportion to the approximation of the voltage at the capacitor linings to the value $U_{c_2} = U_{a\ max} - U_{post}$, the charge current, according to the exponent, is approximated to zero value, and voltage at the tube grid $L_2$, also according to the exponent, is approximated to the value $U_{g_2l} = U_{post}$.

Steepness of the exponent is determined by the duration of the constant time of the circuit of the additionally charged capacitor $t_{2ak}$. If $t_{2ak}$ is small, then the exponent becomes steep and might bring on, during the moment of straight line travel when voltage between the first tube grid and the cathode $U_{gl_1k}$ is less than $E_{go}$, a second opening of tube $L_1$, which leads to undesirable ejection of voltage at tube anode $L_2$ and the appearance of an erroneous comparison impulse To avoid this, a constant time $t_{2ar}$ of large duration is chosen.

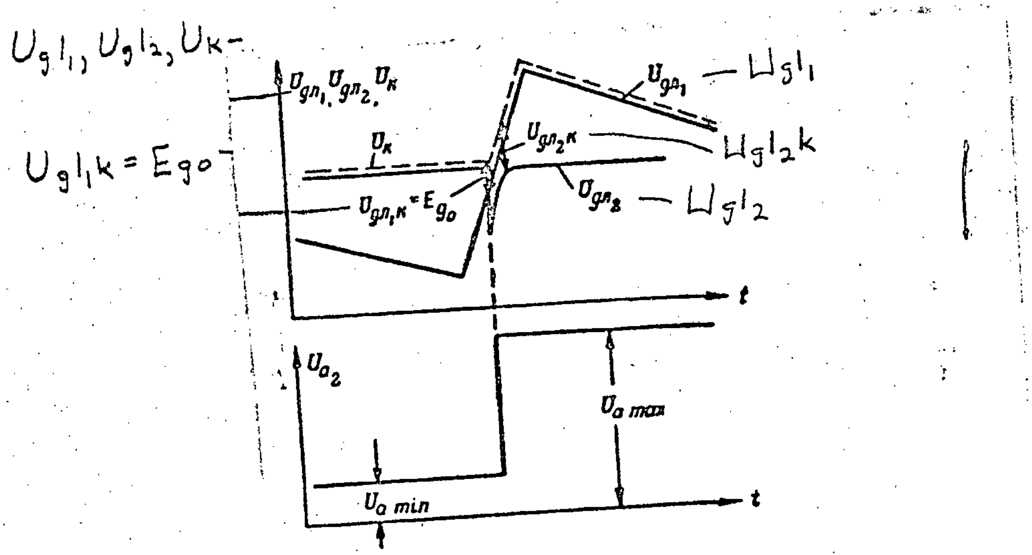



Figure 6. Рис. 6.

The operation of level comparison systems with return "sawtooth" travel is shown in figure 6. As soon as $U_g l_1 k = E_{g0}$ (point 1), tube $L_1$ is slightly opened and capacitor $C_2$ is charged following a voltage drop at anode $L_1$. The capacitor charge travels along the following circuit: left capacitor lining, tube $L_1$, $R_K$, source of auxiliary displacement, 'ground,' Rvykh of the source of constant or slowly changing voltage, diode $L_4$, right lining of the capacitor. With this, a voltage drop is created at the resistance Rvykh, which is applied negatively to tube grid $L_2$, which is additionally closed; and the voltage part at cathodic load $R_K$, which is created by the current of the second tube, drops; $L_1$ is opened to a greater degree, from which the sawtooth voltage is quickly increased; and the capacitor charge current is increased. As a result of this avalanche process, a negative voltage jump is generated at tube grid $L_2$, the tube is closed, but tube $L_1$ is opened; voltage at its anode becomes equal to $U_{g\ min}$; and the capacitor is charged up to the voltage $U_{c_2} = U_{a\ min} - U_{post}$. The charge current, according to the exponent, tends toward zero. Voltage at the tube grid $L_2$ is also approximated to the intensity $U_{post}$.

It is necessary that at the moment of the beginning of straight line travel of the sawteeth, the capacitor $C_2$ be fully charged, for residual voltage at grid $L_2$ leads to the appearance of errors because the comparison of sawteeth will not be carried out with the intensity $U_{post}$, but with a voltage $U_{post} - U_{ost}$, where $U_{ost}$ is this voltage, which is created by the capacitor $C_2$ charge current. To decrease the constant time of the circuit charge, resistance $R_5$ by passes diode $L_4$. With the subsequent increased steepness of the return travel of the sawteeth, the voltage $U_{g l_2 k}$ is always greater than $E_{g0}$. Therefore, there is no danger of a second opening of tube $L_2$ during the period of 'sawteeth' return travel.

"In order that there not be errors in comparison at the expense of high frequency induction at the sawteeth, capacity $C_1$ is included. It is equivalent to the capacity which is included between the grid and the cathod, which is (1+K) times greater than $C_1$. Here, K is the coefficient of tube intensification. All high frequency induction is circuited through this capacity.

However, even with correctly assigned parameters, a level comparison system has operation errors for the overturning system comes about, not at the moment of comparison, but earlier when the voltage between the grid and the cathode of the tube reaches the intensity $U_{g0}$. Thus the error is constant and it might be compensated for by this or another method.

A level comparison system is simply constructed and has stability in operation. Its shortcoming is the necessity for a special sawtooth voltage generator. But there is little difficulty here.

Thorough study by officers of the principle systems and the physical processes which go on in them permits improved use of equipment and the maintenance of equipment in correct condition.

Methods for the Primary Processing of Radar Information in the "Sage" System -- by Engr-Maj N. P. ALFER'YEV (Pages 54-56)

Abstract:

Describes the operation and components of the AN/FST-1 and the AN/FST-2 complexes. Information was reportedly taken from the following non-Soviet press sources: Electronics, business edition, Vol 31, No 28, 1958; Electronics, Vol 32, No 2 1959; Bell Laboratories Records, Vol 37, No 1, 1959; and Missiles and Rockets, No 39, 1959. (Two block diagrams show the workings of the AN/FST-1 and the AN/FST-2.)

## Signal Troops

Apparatus Can and Should Last Longer -- by Lt Col (Res.) M. F. ARTEMENKO and Capt Tech Serv M. I. GRIBKOV (Pages 57-60)

Summary:

An important assignment, issued by the 22d Congress CPSU, is to increase the combat readiness of the PVO Strany Troops. Indicative of how this assignment has been received are the increasing numbers of rationalizers, innovators, and inventors in signal chasti and podrazdeleniya, improvements made in the servicing of technical equipment and the extension of the periods between necessary equipment overhauls.

Examples of how periods between equipment overhauls can be extended can be found in the podrazdeleniye commanded by Officer ARKHIPOV. Here the interval between overhauls of the CT-35 and P-100 apparatus is 5-7 times longer. By lengthening the interval between overhauls of telegraphic equipment, the podrazdeleniye has saved the government 32,000 rubles. This has been accomplished by the following organizational procedures:

Initial servicing and preventive maintenance are accomplished at the operations site by mechanics who are relieved from operator duties during maintenance. Preventive maintenance has been carefully scheduled so that one mechanic is always on duty to perform daily preventive maintenance and so that monthly preventive maintenance performed by mechanics who service only the equipment which is assigned individually to them. The commander of the podrazdeleniye, aided by his deputies and shop chiefs, has drawn up a long-term plan for the annual and monthly overhaul of apparatus, which includes data on the annual plans for telegraphic equipment usage, general condition of equipment, and normal intervals between equipment overhaul. Innovations and suggestions by operators and mechanics have served to lengthen the interval between equipment overhauls. Party and Komsomol organizations have been aided by actively disseminating technical propaganda and initiating technical conferences, technical evenings, and other gatherings to help personnel in the technical mastery of their equipment.

However, there are still shortcomings, even in this leading podrazdeleniye. Many telegraph operators are still unable to conduct primary preventive maintenance because they lack technical training. Long periods of equipment operation between overhauls can be brought about only through the better and more attentive training of operators and mechanics.

Microminiaturization of Radiotechnical Apparatus -- by Engr-Col N.S. SHISHONOK, Candidate of Technical Sciences and Docent (Pages 60-65)

Abstract:

The article, based on foreign press sources, discusses three basic trends of microminiaturization: development of equipment which uses micromodules as a base; development of sputtering microcircuits; and construction of solid monolithic semiconductive circuits. Sources used include: The Army Micro-module Program, RCA, 1959; Proceedings of the IRE, No. 5, 1959; Electronics, No. 36, 1959; IRE National Convention Record, March 1959; Electronics, April 1960; Electronics, No. 32, 1959; Electronics, No 7, 1960, and Wireless World, No11, 1959

Illustrations depict the following: 1. microelements: a) a resistor, b) a capacitor, c) a LC circuit composed of a sputtering capacitor and an inductor in the form of a ferrite toriod with coil, d) a micromodule assembly; 2. microelements: a) resistors b) capacitors c) semiconductive devices d) conductors; 3. circuits and exterior views of: a) a pulse generator b) an intermediate frequency amplifier; 4. structures of four RC circuits in the form of pole shoes with distribution parameters achieved by methods of microcircuitry; 5. circuits of: a) a generator b) a multivibrator; 6. four solid circuit elements: a) a resistor b) a capacitor c) an RC circuit d) a transsistor; 7. a circuit of a multivibrator with a double stable condition; and 8. solid circuits of a low frequency amplifier, a multivibrator, and a double cascade video amplifier.)

## Military Training Institutions

In the Interests of Improving the Quality of Instruction -- by Col I. Ya. GOLUBEV (Pages 66-69)

Summary:

We must produce officers who are well trained in military theory and in the use of scientific equipment, who have thorough knowledge of Marxist-Leninist sciences, who have mastered their specialities, and who are able to methodically train subordinates. We must graduate not narrow military specialists, but engineer-officers with broad mental outlooks based on the ideas of Marx and Lenin. In order to fulfill these assignments, we must improve the pedagogical mastery of instructors and develop teaching methods of the highest quality.

That school instruction is constantly being improved is evidenced by the growing number of school instructors who are working on candidate dissertations or by instructors like Engr-Col SHISHONOK, and Engr-Majs VAVILOV and VOLKOV who are working on their doctorates. Recently Engr-Lt Cols SAFRONOV and POLYANSKIY, Engr-Capt IVANOV, and Engr-Sr Lts BOGDANOV and MILEN'KIY successfully defended their candidate dissertations. In the chair headed by Engr-Col MILENIN where Lt Col LYASHENKO is secretary of the party organization, all instructors have taken the candidate minimum.

Party organizations have an important role to fill in maintaining and aiding the increasing of instructional quality. Thus, when the party committee learned that Instructor KRUSHEVSKIY was preparing and delivering his lectures poorly, members of the party committee brought

his instructional shortcomings to light and then helped him to correct them. The skills of officers like Engr-Cols SAVENKOV, LABETS, and TSIKUNOV; Cols VLASOV and YARKHUNOV; and Engr-Lt Col ZAYTSEV in relating the subjects which they teach to life and to party activities, have been systematically disseminated to other instructors by means of meetings, seminars, and conferences under the guidance of party organizations. Other instructors, whose instructional skills are propagandized by party organizations, include Engr-Lt Col GRIGOR'YEV; Lt Cols OVSYANNIKOV, BUTVIN, and OVCHARENKO; and Engr-Maj KOROLEV.

Fine educational results have been obtained from meetings where experiences obtained during periods of practical training (stazhirovka) are exchanged. An example of one such meeting was the one held by the course, led by Lt Col OSTROVSKIY, during which Engr-Lts KOVAL'CHUK and UDOTOV related their practical training experiences.

(A captioned photograph by V. KOSTYIEV shows Engr-Maj Ye. VAVILOV, senior instructor, aiding Engr-Sr Lt Yu. BUZUNOV in the preparation of the defense of BUZUNOV's candidate dissertation, and is now working on his doctorate.)

<u>A Thorough Knowledge of Radioelectronics for Officer Candidates</u> -- by Engr-Lt Col S. M. MAYEV (Pages 70-73)

Abstract:

Discussed instructional methods and laboratory work carried on in schools which train officer candidates in radioelectronics. Fields of study mentioned include mathematics, physics, logic, political theory including study of the work of Soviet and foreign scientists, and military and command practices. Officers SHEKERA, VAL'CHUK, and BORODINOV are identified.

Excerpt:

In composing of [study] plans, we attempt to ensure the necessary sequence of training.... Therefore, these documents are discussed at method meetings. This planning procedure allows the study of specialties, and establishes the correlation between courses necessary to eliminate parrallelism.

Experience has shown us the following sequence for training officer candidates. At the beginning of the training year, officer candidates of the first course study the theoretical fundamentals of electrical engineering - electrostatics, direct current, magnetism and electromagnetism, alternating current. After this, they begin the study of radio equipment.

The extended period of study of radioequipment follows this sequence: first, electric vacuum and ionic devices; then, oscillating circuits, propagation lines, and antennas. The program of the first course concludes with the subject, 'pulse techniques.' Practice has shown that such an order of training has important shortcomings. During the study of tubes and their use, there was a large time break. Due to this, the mastery of pulse equipment by officer candidates was impeded. Therefore, at the present time the study of radioequipment is begun with oscillation circuits. This method ensures the best sequence and the connection of the study of radioequipment with radioelectronics.

It is proposed that the study of pulse equipment be transferred from the first to the second course. This change is called for since officer

[redacted]

candidates in the first course do not have the sufficiently broad technical background to master this equipment easily. This change also eliminates the break in time between the study of pulse equipment and the special courses. Also, there are plans for first course officer candidates, following their study of tubes, to work with radiotransmission equipment, pulse equipment, principles and fundamentals of radar, and problems with automatic equipment.

Improve the Methods of Technical Training of Future Officers -- by Engr-Lt Col L. Z. ZIL'BERMAN (Pages 73-75)

Abstract:

The article makes two suggestions for improving the technical training of officers. The first suggestion is for instructors to issue lesson summaries prior to lectures to provide more classroom time for visual materials and to ensure that students grasp material when presented rather than causing them to interpret it later from notes. The second suggestion is for more attention to be given to teaching the principles of equipment operation so that students learn not only how to repair defects in equipment, but also how to locate defects through a knowledge of the basic construction of equipment.

A note from the editors invited readers' comments.

History of PVO Strany During the Heroic Defense of Odessa -- by Maj Gen Arty T. I. ROSTUNOV (Pages 73-80)

Abstract:

The article presents a textbook description of the defense of

Odessa during World War II, giving special emphasis to the role of the antiair defense of the city. (a map shows the deployment of the antiair defense forces of Odessa on 5 July 1941.)





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